# News Release

No. 0560006-2 (Fort Belvoir stabilizes stream with Bendway weirs)

By Susan Phelps

Mike Hudson, natural resources specialist at Fort Belvoir, recently introduced a low-cost, long-term stream restoration technique to the Virginia installation that will realign a stream channel, save a bridge, stabilize erosion, and provide more habitat for area wildlife. This multi-faceted methodology is called Bendway weirs and according to Hudson, “It’s a well-engineered, environmentally sensitive approach to reducing streambank erosion.”

From an outsider’s point of view, Bendway weirs seem like a simple technology. They are basically horizontal piles of large rocks that extend from the stream’s bank to the deepest part of the stream channel. Learning more about weirs, however, one finds that they are a unique blend of engineering and environmental disciplines that require precise measurements and placement. Once established, Bendway weirs are a system that capture, control, and redirect the current of a stream and its energy away from the streambank, where erosion occurs, to the center of the channel.

Hudson learned of this methodology while taking a streambank erosion protection course at the U.S. Army Corps of Engineers Waterways Experiment Station in Vicksburg, Miss. Upon returning to Fort Belvoir, Hudson was asked to review a streambank erosion control project for Accotink Creek. The post was planning to designate Panther Bridge, which crosses the creek, as the main thoroughfare to the Davison U.S. Army Airfield. The bridge’s stability,

however, was threatened by the stream's flow that was directed at one of the bridge's support structures.

Fort Belvoir's engineering staff initially proposed a traditional approach that included dredging the stream and cementing boulders (grouted rip rap) along the stream channel as it passed under the bridge. Although this approach would have channelized the flow away from the bridge's abutment, it would have done little to stop the erosion that was occurring immediately upstream. It would also have reduced the habitat in and around the stream, making it less suitable for fish and other aquatic life. According to Hudson, "armoring a channel makes the stream less predictable. It can change the whole ecosystem of a stream."

The concept for Bendway weirs was developed at the Corps' Waterways Experiment Station. Since its inception in 1988, the methodology has been used to realign and stabilize a number of streams and rivers across the United States, including the Mississippi River. The results have been encouraging. "Analysis of the five oldest weir systems in navigational channels show that from 1990 to 1995, dredging was reduced by 80%, saving $3,000,000. In addition, towboat accidents were reduced, tow delay times at bends were reduced, sediment and ice management was improved, nesting areas were undisturbed, aquatic habitat areas increased, and fish size and density increased five fold in some areas," said David Derrick, research hydraulic engineer at the Waterways Experiment Station.

In December 1996, Derrick arrived at Fort Belvoir to assess the stream and its characteristics. Using such instruments as a tape measure, tile probe, and aerial photographs, Derrick gathered information on the physical characteristics of the creek, the amount and direction of flow, the creek's history, and flooding events. He used this information along with the goals of the project to design a Bendway weir system for Accotink Creek. According to Derrick, "Changing the direction of a waterway is a powerful tool. A

successful weir installation requires a thorough understanding of the Bendway weir theory and extensive knowledge of the stream or river in which the structures are placed."

Through his analysis, Derrick determined the length, height, and width of each weir and how far apart they should be spaced. He also identified the upstream angle for each weir in the streambed. This measurement is particularly important since it has the most impact on directing the stream flow. Other factors included the type and amount of material the weirs are composed of. Fort Belvoir used stones weighing 200 pounds each for its weirs. Other weir materials include trees and geobags (polypropylene bags filled with sand).

In September 1997, five Bendway weirs were installed in Accotink Creek. To ensure the stability of the project, the weirs were anchored into the streambank with "keys." Keys are rock extensions of the weirs that are entrenched into the streambank. They prevent the stream from flowing behind the weirs and eroding a new channel behind the weir system. Another technique that was used with the weirs was longitudinal peaked stone toe protection. This technique involved strategically placing a low wall of rocks at specific points along both sides of the streambank to prevent erosion by stabilizing the streambanks and helping redirect the stream flow.

Combined together, the weirs, the keys, and the toe protection are capturing the Accotink Creek's flow and diverting it away from the outer bend of the bank toward the center of the stream. As the flow passes through the stream bend, the weirs control the flow and slow its erosive force. The last weir at the end of the system is aiming the stream's flow under the center of the bridge, away from the abutment.

Over time, the weirs will do more than save the bridge. They will help improve the overall health of the stream and increase streambank stability by encouraging sediments to deposit on the outside bend of the stream where

erosion is greatest. The weirs will help reduce the erosion of the streambank by breaking up the strong currents of the stream and diverting the flow away from the outer bend to run parallel to the streambank. This will ensure that the deepest part of the channel is in the center of the stream and not at base of the streambank.

The weirs will also help reduce erosion during storms because they work best when there are high-flow, high-energy conditions. The weirs will provide a diversity of habitat for fish and other aquatic life that may help increase their populations and diversity. According to Derrick, “Weir effects can be predicted for 100 feet downstream of the last weir. They blend well with other bank protection techniques and usually cost the same or less than traditional engineering methods.”

Hudson is pleased with the results so far and is considering the use of Bendway weirs on another bend of Accotink Creek further upstream. “I’m fairly convinced that this is going to be a successful project. I would urge others to consider this as an alternative to traditional engineering approaches, because it combines the best of both worlds —— engineering and environmental —— to use the forces of nature to protect the streambank.”

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